

REMARKS

Upon entry of this Amendment, claims 1-29 are all the claims pending in the application. Claims 27-29 have been added.

Applicant wishes to thank the Examiner for acknowledging receipt of all certified copies of the priority documents and for indicating that the drawings filed on “October 17, 2002” are approved. However, Applicant wishes to point out that the drawings were filed on June 17, 2002 and not on October 17, 2002. Clarification of the filing date of the accepted drawings is kindly requested.

In regard to examined claims 1-26, although presently objected to as being dependent upon a rejected base claim, the Examiner has indicated that claims 7-15, 17-20, 21/7-15, 21/17-20, 24 and 25 would be allowable if rewritten in independent form. Claims 1-6, 16, 21/1-6, 21/16, 22, 23 and 26 presently stand rejected. Specifically, claims 1-6, 21/1-6, 22 and 23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Stevenson, Jr. (USP 4,126,867) (“Stevenson”) in view of Osawa et al. (USP 6,106,091) (“Osawa”); and claims 16, 21/16 and 26 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Stevenson in view of Osawa and further in view of Araki (USP 6,312,077).

For the following reasons, Applicant respectfully traverses the prior art claim rejections and requests favorable disposition of the application.

I. Claim Rejections Under 35 U.S.C. § 103

Summary

Independent claims 1 and 21 define a new and nonobvious combination which forms a head driving apparatus. Included among the features of this new head driving apparatus is a head driver comprising a bias power supply source that applies a bias voltage of a predetermined value to the common electrode of each of a plurality of piezoelectric elements. At least this feature of the claimed combination is neither taught nor suggested by Stevenson in view of Osawa and, therefore, the rejection of claims 1-6, 21/1-6, should be withdrawn.

Independent claim 22 defines a new and nonobvious method which includes the application of a bias voltage to the common electrode of each of a plurality of piezoelectric elements. At least this feature of the claimed method is neither taught nor suggested by Stevenson in view of Osawa and, therefore, the rejection of claim 22 should be withdrawn.

Claims 16, 21/16 and 26 depend from at least one of patentable claims 1, 21 and 22. For at least this reason, claims 16, 21/16 and 26 are patentable over the prior art and the rejection thereto should be withdrawn.

The Prior Art References

Stevenson discloses an electronic circuit for driving an ink jet print head. In order to enable an increase in the switching speed of the driving circuit, a transistor within the driving circuit is biased in a manner “to keep the current flow therethrough substantially constant.” (Col. 1, lines 53-54). In one embodiment, illustrated in figure 3, a biasing transistor, Q4, biases the input voltage to switching transistor Q1. The output of switching transistor Q1 is then amplified

by the amplifier circuit comprising transistors Q2 and Q3 and this amplified signal is passed on to the piezoelectric element 17 as a drive signal to initiate ink ejection from the print head.

Accordingly, the drive circuit is connected to the drive electrode of piezoelectric element 17 and the opposite electrode is connected to ground.

In a second embodiment in Stevenson, illustrated in figure 4, two switching circuits, 51 and 53, are provided. The first switching circuit, 51, is responsive to the control pulse 33 and connects the high voltage V_H to the piezoelectric element 17 for the duration of the control pulse. The second switching circuit, 53, is also responsive to the control pulse 33, but controls the discharge of the capacitance of element 17. (Col. 5, lines 40-50). Both switching circuits, 51 and 53, are connected to the drive electrode of element 17 while the opposite electrode is connected to ground.

Osawa is directed to a method of driving an ink-jet head that selectively deposits ink droplets on an image recording medium. According to Osawa, due to free oscillations in the piezoelectric actuators of conventional print heads, ink droplets “break-up” or are “vaporized” upon delivery when “the piezoelectric actuators are driven at a high frequency in order to increase printing speed.” (Col. 2, lines 13-14). To address this stated problem, Osawa proposes two embodiments of a print-head driving method. In the first embodiment, the process of supplying ink to the ink chamber of the print-head is divided into two steps. The first step is conducted quickly and the second step is conducted more slowly, relative to the speed of the first step. (Col. 3, line 62 through Col. 4, line 4; and Fig. 1). By dividing the filling process into two steps, as described, free oscillations in the piezoelectric actuator are apparently avoided.

In a second embodiment, Osawa discloses a method by which the size of each ink droplet ejected out of the nozzle holes of the print head is adjusted “by varying a magnitude of a voltage and a length of time for driving the piezoelectric actuators.” (Col. 4, lines 54-55). In accordance with the second embodiment, illustrated in figure 5, an output voltage P_C is applied to a cathode side of diode D1 while the anode side of D1 is connected to one of the terminals of resistor R1 for adjusting a discharge time constant. (Col. 9, lines 17-21). The anode side of D1 is also connected to the collective side of piezoelectric actuator 10.

Argument

As acknowledged by the Examiner, Stevenson does not teach or suggest a bias power source that applies a bias voltage to the common electrode of each of a plurality of piezoelectric elements, as recited in claim 1. The Examiner does, however, assert that Stevenson teaches a bias power source (51 in Fig. 4) and that Osawa suggests applying a bias voltage (P_C in Fig. 5) to the common electrode of a plurality of piezoelectric elements 10. Further, the Examiner asserts that it would have been obvious to apply the bias voltage supplied by “bias power source” 51 in Stevenson to the common electrode of each of a plurality of piezoelectric elements 10, as disclosed in Osawa. The proffered motivation for doing so, according to the Examiner, is “to adjust the discharge time constant to avoid the free oscillation inside the ink chamber that causes the undesired ink ejection in order to gain printing quality as taught by Osawa et al.”

For at least two reasons, however, the Examiner has failed to set forth a *prima facie* case of obviousness. First, contrary to the assertion of the Examiner, element 51 from figure 4 of Stevenson is not a “bias power source”. The circuit 51 in Stevenson is explicitly described as a

“switching circuit” (Col. 5, line 62) and not a power source. Regardless of the function of circuit 51, however, if circuit 51 in Stevenson were connected to the common electrode of piezoelectric element 17, as proposed by the Examiner, piezoelectric element 17 would not operate at all, let alone for its intended purpose. “If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.” (MPEP §2143.01, citing, *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)).

The same drive circuit, circuit 51 in Stevenson figure 4, cannot be connected to both the drive side and the common side of the piezoelectric element. Doing so would clearly render the piezoelectric element inoperative. Therefore, a skilled artisan would not have been motivated, for any reason, to modify the circuit in Stevenson in the manner suggested by the Examiner. For at least this reason, *i.e.*, there being provided no reasonable motivation for a person skilled in the art to modify Stevenson as suggested, a *prima facie* case of obviousness has not been established and the rejection should be withdrawn.

Furthermore, “if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious.” (MPEP §2143.01, citing, *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)). Here, the proposed modification of the Stevenson circuit, *i.e.*, applying the output of circuit 51 to the common electrode of the piezoelectric element 17, would at least alter the principle of operation of the drive function, if not render it inoperative altogether, as discussed above. The “suggested combination of

references would require a substantial reconstruction and redesign of the elements shown in [Stevenson] as well as a change in the basic principle under which the [Stevenson] construction was designed to operate.” 270 F.2d at 813, 123 USPQ at 352.). For this additional reason, a *prima facie* case of obviousness has not been established and the rejection should be withdrawn.

Lastly, Applicant submits that the claimed combination, as set forth in claim 1, is not obvious. The motivation to combine the independent teachings of the prior art references, as suggested by the Examiner, is merely the reasoning espoused by the inventors in Osawa for arranging their disclosed circuit. This reasoning cannot be applied to the circuit of Stevenson. In particular, in order to establish a *prima facie* case of obviousness, the Examiner must at least provide some reason, suggestion, or motivation from the prior art as a whole for the person of ordinary skill to have modified the Stevenson circuit to provide a bias voltage to the common electrode of the piezoelectric elements.

The Examiner argues, in essence, that because the drive circuit and piezoelectric element disclosed in the background section of Osawa experienced oscillations requiring the addition of a circuit for controlling the “discharge time constant”, then all drive circuits and piezoelectric elements would benefit from the addition of the “discharge time constant” control circuit. This line of reasoning is faulty at least because there is no indication whatsoever, in Stevenson or any other prior art reference, that the oscillations experienced in Osawa occur in any circuit other than the circuit disclosed in the background of Osawa. A skilled artisan would not have been motivated, absent the teachings of the present application, to modify the drive circuit of Stevenson consistent with claim 1. Accordingly, the claimed combination is nonobvious and the

rejection, at least as it applies to claim 1, and all claims dependent on claim 1, specifically, claims 2-20, should be withdrawn.

Claim 21 includes at least the same head driver discussed above in regard to claim 1. Therefore, for at least the same reason as set forth above with respect to claim 1 and, further, because the Araki reference fails to compensate for the deficiencies of Stevenson and Osawa, claim 21 recites subject matter that is neither taught nor suggested by the prior art and the rejection of claim 21, and all claims dependent thereon, should be withdrawn.

Claim 22, as well as all claims dependent on claim 22, specifically, claims 23-26, recites, *inter alia*, “applying a bias voltage having a predetermined potential from the bias power source to the common electrode of each piezoelectric element.” Thus, for reasons similar to those set forth above in regard to claims 1 and 21 and, further, because the Araki reference fails to compensate for the deficiencies of Stevenson and Osawa, claim 22 recites subject matter that is patentable over the prior art. Accordingly, the rejection of claims 22-26 should be withdrawn.

II. New Claims

For additional claim coverage merited by the scope of the invention, Applicant has added new claims 27-29. Applicant submits that none of the cited prior art references disclose, teach, or suggest the combination of features contained therein.

Conclusion

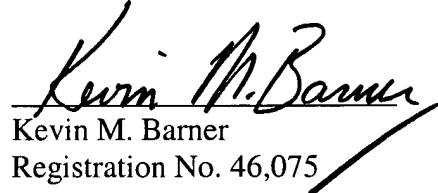
In view of the foregoing remarks, the application is believed to be in form for immediate allowance with claims 1-29, and such action is hereby solicited. If any points remain in issue

AMENDMENT UNDER 37 C.F.R. § 1.111
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which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to **contact the undersigned** at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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PATENT TRADEMARK OFFICE

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 27-29 are added as new claims.

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